
Description

This chapter describes the NTAG36 Meridian Integrated RAN (MIRAN), both at a system level and at a card level. It describes functions, specifications, applications, engineering guidelines, and operation of the MIRAN.

System overview

The MIRAN is an Intelligent Peripheral Equipment (IPE) card compatible with Meridian 1 options 21E, 51, 51C, 61, 61C, 71, 81, and 81C. It is also compatible with Options 11E and 11C system and SL-1 systems NT and XT upgraded to support IPE cards.

The system software required to support the MIRAN operation must be X11 release 20 or later.

The MIRAN application software is shipped preinstalled in MIRAN.

The MIRAN provides multi-tasking voice processing applications such as recorded announcement (RAN) and music-on-hold (MOH).

The MIRAN communicates with X11 system software using trunk signaling messages over the DS-30X link and emulates the Enhanced Universal Trunk card. The overlays used to configure the Enhanced Universal Trunk card, trunk routes, and trunk functions are used to configure the MIRAN routes.

It provides up to eight internal one-to-one trunk emulation ports/channels and one or two external multi cross-connect channels to support RAN and MOH applications. Each multi cross-connect channel may connect to up to 16 external trunk ports at the MDF.

The largest single MIRAN card provides 8 trunk emulation ports/channels and 2 multi cross-connect channels, for a total of 10 RAN/MOH channels.

PCMCIA Flash memory cards are used to expand the MIRAN message storage memory, to install new RAN and MOH applications, and to backup messages from the MIRAN to the PCMCIA card. If only 4 minutes of message storage capacity is required, it is provided internally in the MIRAN and a Flash memory card would not be necessary for this purpose.

A maximum of 16 MIRAN cards can be linked in a LAN configuration to expand the RAN capacity beyond that provided by a single MIRAN card. This LAN configuration allows one terminal to access any MIRAN in the chain for the purpose of maintaining and configuring individual MIRAN cards and their RAN and MOH applications.

The MIRAN connects to a maintenance terminal over an RS-232 port and to an external music source over an analog I/O port. This port can also be used to input music or voice to a tape recorder. An additional analog port is available on the backplane. A telephone set can also be used to configure the MIRAN, to record new announcements, and to swap existing announcements in and out of service. To use a telephone set, one port out of eight one-to-one ports/channels must be configured as a DID port dedicated to the telephone set.

Figure 1 illustrates the communication bus structure between the MIRAN and the Meridian 1 CPU as well as the Peripheral Controller in the IPE module.

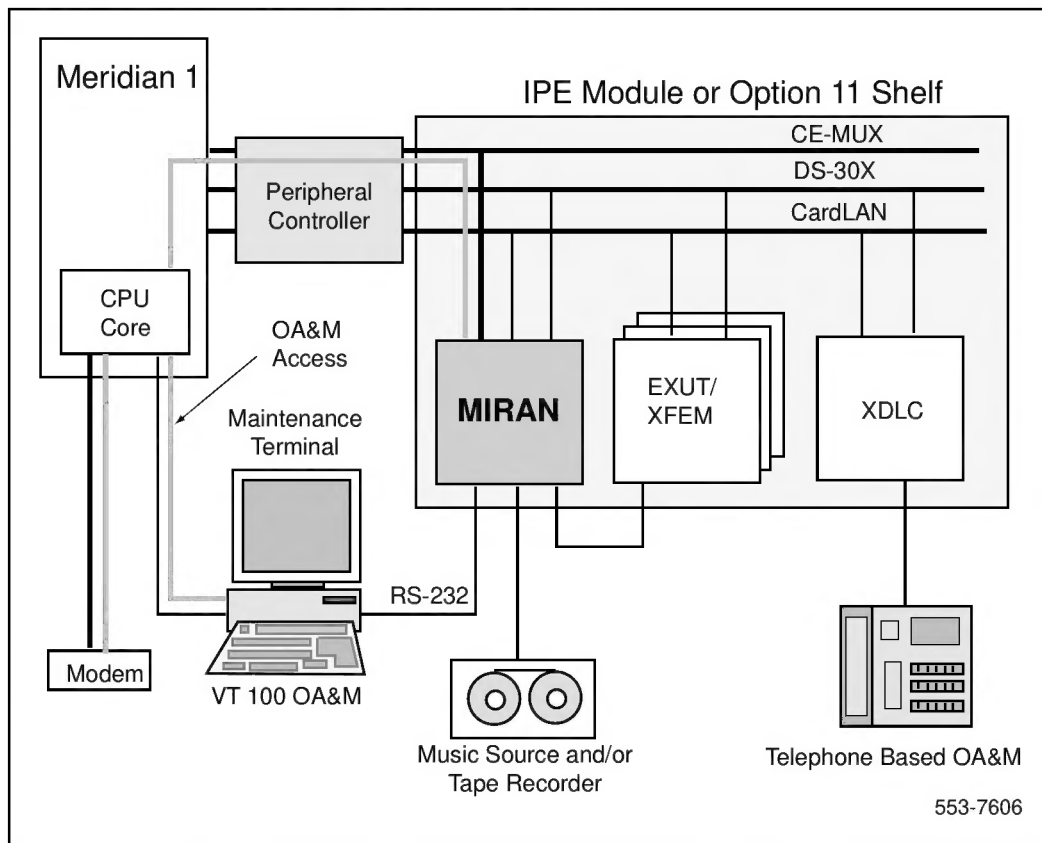
The terminal-based OA&M access is provided by the RS-232 maintenance port on Meridian 1 or Option 11E/11C systems, or, alternatively, over the CE-MUX using the pass-through feature on Options 11E and 11C. The MIRAN can also support Play, Delete, Record, and Assign functions for simple messages using a telephone set-based OA&M.

MIRAN description

The MIRAN emulates the NT8D14BA vintage or greater Enhanced Universal Trunk card. The trunk card software that supports the MIRAN was first introduced in X11 release 20. Software releases prior to X11 release 20 are not capable of supporting the MIRAN.

The MIRAN emulates any DS-30X signaling protocol, including TCM signaling, to be compatible with existing and future terminals and consoles. In addition, MIRAN provides unrestricted access to any one of the 32 voice channels on a DS-30X loop for both voice and data applications.

Figure 1
MIRAN interface structure in the Meridian 1 system



The enhanced flexibility of the MIRAN card provides:

- easily expandable, industry-standard architecture (small, medium, and large configuration controlled by keycode)
- a set of both standard and proprietary interfaces
- compatible with all systems that support IPE cards
- embedded real time operating system
- support for CE-MUX and Card-LAN

- provides simplicity of the basic system (no external devices or cables)
- versatile storage capacity features provide for:
 - A minimum of 4 minutes of recording storage on the base MIRAN
 - Up to 16 different messages per channel per day switchable on a time-of-day basis
 - In-system upgradeable MIRAN with plug-in PCMCIA ATA Flash cards to more than five hours of storage
 - Up to eight internal one-to-one RAN or MOH port/channels, which support continuous and start/stop RAN mode (seven, if one is used for telephone set-based OA&M access)
 - Two cross-connect channels, which are cross-connected to a maximum of 16 trunk ports each, to provide a total of 32 RAN or MOH channels, which support only continuous RAN mode
 - Music and voice storage to the limits of the available Flash memory
 - Connection of up to two external analog (music) sources for recording and playing
- a versatile set of recording features that include the following:
 - Different messages programmed to play at different times of day
 - Batch files, which allow rapid reconfiguration in case of emergency
 - Swapping of “in-service” and “in-reserve” messages using a set
 - Message backup and restore capability
 - Existing announcements can be transferred to the MIRAN
 - New messages recorded over a telephone or from common plug-in audio equipment (e.g., CD players, cassette players, etc.)
 - Password-protected RAN recording from any DTMF telephone set using a simple voice menu interface
 - Professional recordings supplied to the customer on PCMCIA Flash cards for RAN and MOH
 - Music storage up to the limit of available Flash memory
 - Music recording provided on two external analog ports

MIRAN design characteristics

The MIRAN card supports voice processing by providing connectivity to the Meridian 1 system, voice storage capacity, and access to an OA&M facility.

The MIRAN:

- is based on an industry standard 486 processor core
- uses standard interface buses (PCI, ISA, and PCMCIA)
- uses proprietary Nortel DSP cards to access advanced DSP functions
- accesses all 32 DS-30X voice/signaling timeslots
- supports CE-MUX and Card-LAN interfaces
- provides two RS-232 serial ports for maintenance access (through the faceplate Mini-DIN connector and through the backplane connector or MDF). Port B connects to the terminal and port A is used together with port B for daisy-chaining multiple MIRAN cards into a LAN for a single terminal access
- supplies two audio channels for analog access (both input and output)
- provides up to two multi cross-connect outputs for connecting to trunk channels

Table 1 lists specific MIRAN hardware components designed to support RAN and MOH applications in the Meridian 1 and SL-1 systems.

External equipment such as terminals, telephone sets, recorders, and PCMCIA cards are not listed because they are a third party generic products.

Table 1 describes hardware components provided for MIRAN application.

Table 1
MIRAN hardware list

Component	Description
NTAG36 Meridian Integrated RAN (MIRAN)	An IPE card that provides RAN and MOH applications over the Meridian 1 system. (NTAG36 plus security device= NTAG88)
NTAG81AA Audio Cable	Connects external analog music source or a recording device to the 3.5 mm Audio Jack on the MIRAN faceplate. This is a splitter cable that provides the audio input signal on one connector and the audio output signal on the other connector.
NTAG81BA Maintenance Extender Cable	A 5-meter (16.4 feet) cable extends the NTAG81CA or the NTAG81DA Maintenance Cables when connecting a terminal to the MIRAN. Has one 9-pin D-Sub male and one 9-pin D-Sub female connectors.
NTAG81CA Maintenance Cable	A 3-meter (9.8 feet) cable that connects the terminal to the MIRAN Mini-DIN maintenance port on the faceplate. It is terminated with a 8-pin Mini-DIN male connector and a 9-pin D-Sub female connector.
NTAG81DA Maintenance Splitter Cable	A 3-meter (9.8 feet) cable connects the Mini-DIN connector on the MIRAN faceplate to a terminal or to an adjacent MIRAN to form a LAN daisy-chain. It has an 8-pin Mini-DIN connector on the common side and two 9-pin D-Sub connectors, one male and one female, on the split side.
NTBK48AA Terminal Cable	Connects Option 11E/11C SDI port to the terminal.
3MB PCMCIA Card	Used for software upgrade and storage.
40MB PCMCIA Card	Used for backup, upgrade, and storage.

MIRAN capacity expansion

If more capacity is required than eight one-to-one trunk emulation ports/channels a single MIRAN can provide, multiple MIRAN cards can be installed. However, if a telephone set is used to record the announcement into the MIRAN, one of eight one-to-one trunk emulation ports/channels must be configured as a DID port to connect the maintenance telephone set to the MIRAN, allowing only seven one-to-one trunk emulation ports/channels for recording announcements. If multiple MIRAN cards are used, you must configure port 7 for each MIRAN card as a DID trunk for telephone set-based OA&M access even though only one telephone set is used.

Up to sixteen MIRAN cards connected in a daisy-chain can be controlled from a single terminal. A low-speed connection between multiple MIRAN cards is possible to allow OA&M facilities on multiple cards to be accessed from a single terminal.

Port/channel expansion

One-to-one recording ports/channels on the basic RAN application emulate the Enhanced Universal Trunk card. Thus, current software can support a voice or music recording capacity of up to eight ports per MIRAN card.

In addition to the eight one-on-one trunk emulation ports/channels, up to two multi cross-connect channels are also provided, ten total ports/channels are available in the largest of the three MIRAN capacity options, as shown in Table 2.

Table 2
MIRAN capacity options

MIRAN capacity option	No. of Multi cross-connect channels	No. of one- to-one ports/channels
Small	1	4
Medium	2	4
Large	2	8

Note: Each MIRAN capacity option consists of the NTAG36 MIRAN card, NTAG37 Software Load (pre-loaded on the card), NTDK57 Security Device, and a Keycode.

Each of the two cross-connect channels can be cross-connected with 16 (600 Ohm) trunks or 16 (900 Ohm) trunks to provide a total of up to 32 trunks.

For each capacity option in Table 2, a MIRAN one-to-one port can be configured for telephone set-based OA&M. Also, note that only one-to-one ports/channels have Enhanced Universal Trunk card emulation; the two multi cross-connect channels do not.

Functional description

The NTAG36 MIRAN software and hardware architecture is an effective implementation of RAN and MOH applications for Meridian 1 and systems supporting IPE cards.

The MIRAN provides faceplate and backplane interfaces, which are used to connect external RAN and music sources and maintenance terminals to the MIRAN. The hardware description provides information on the faceplate connectors and indicators as well as the backplane connections to the MDF.

Software architecture

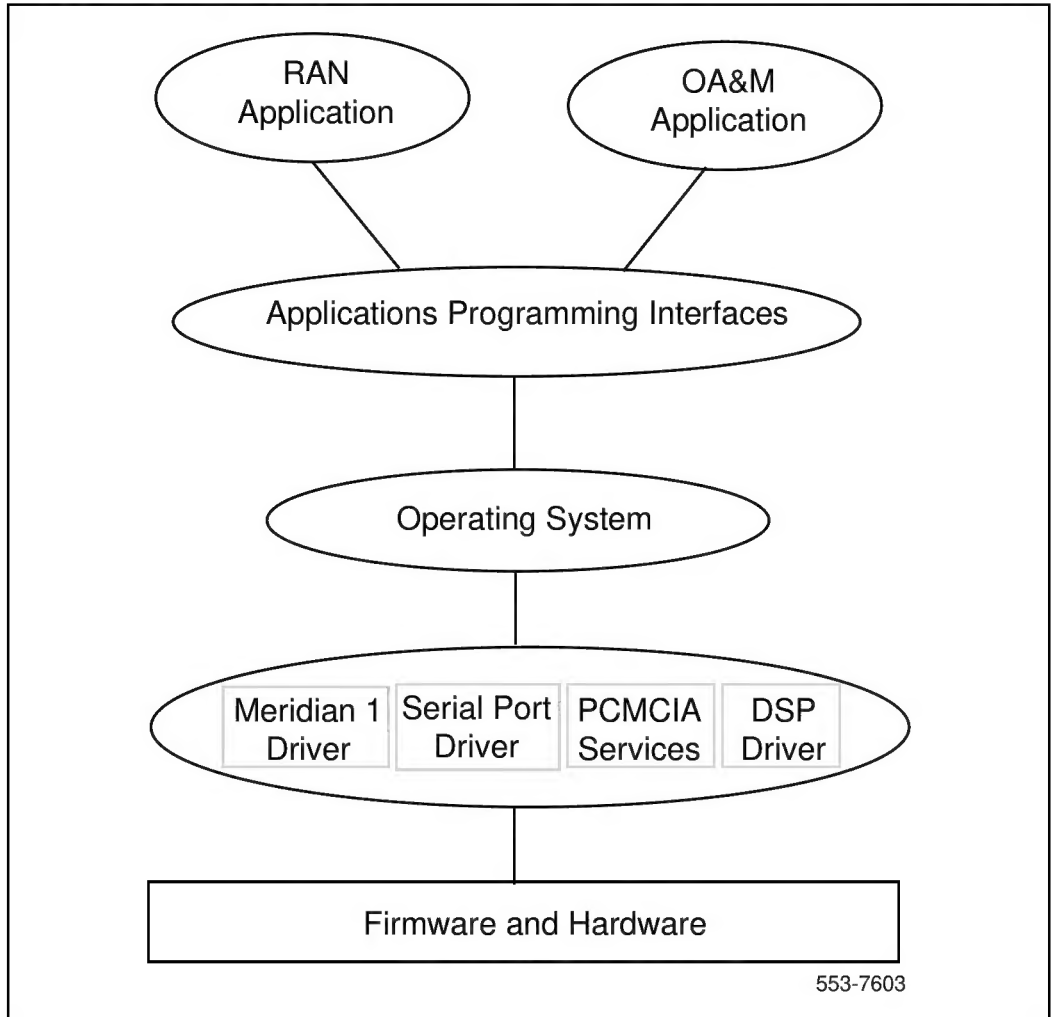
The MIRAN software architecture incorporates the VxWorks real time operating system that allows easy future expansion of features and services.

The MIRAN kernel is an off-the-shelf real-time operating system that supports real-time applications. It supports message queues, pipes, semaphores, asynchronous signals and intertask communication.

The operating system code must be loaded from internal Flash into DRAM unless the MIRAN has a bootable Flash memory card containing the OS code.

Figure 2 illustrates the basic MIRAN software architecture with RAN and OA&M applications, the operating system, and the MIRAN drivers.

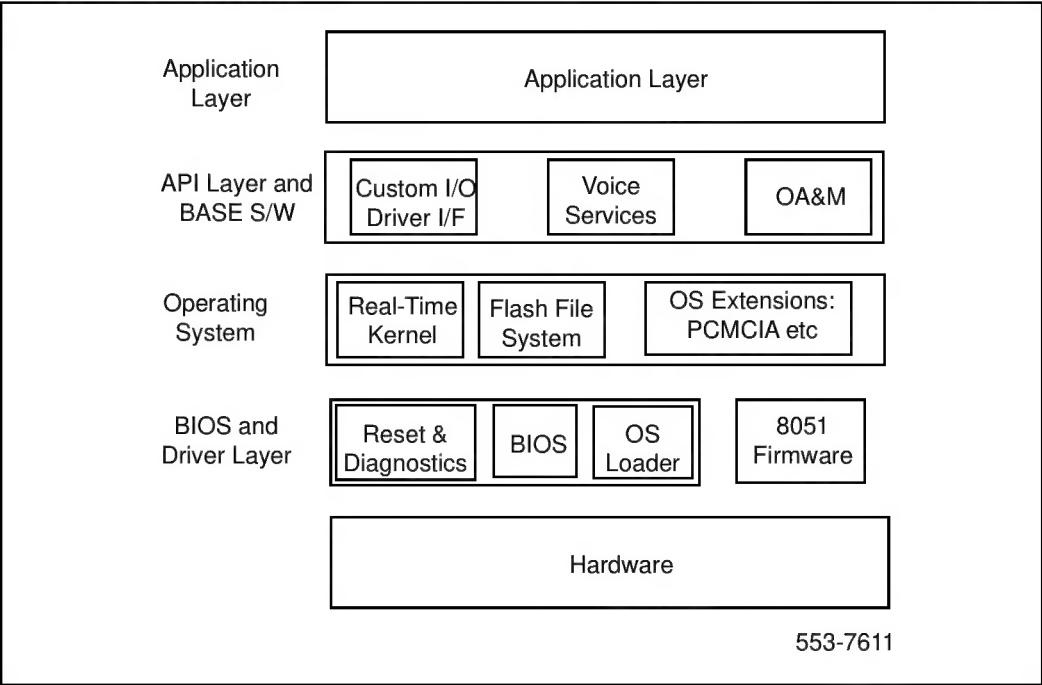
Figure 2
MIRAN software architecture



These procedures initialize the hardware and boot the operating system, using the low level reset, self-test, and BIOS initialization.

Figure 3 illustrates the MIRAN software communication layers.

Figure 3
MIRAN software layers



Hardware architecture

The MIRAN is designed with the 486 microprocessor as its core. The microprocessor interfaces directly to the DRAM array and cache memory and to the rest of the system over PCI and SAI buses. Peripheral interfaces such as RS-232 maintenance interface and PCMCIA interface, connect to one or the other of these buses.

Meridian 1 interfaces such as Card-LAN, DS-30X, and CE-MUX connect to a dedicated microcontroller. This microcontroller communicates with the core microprocessor over the dual-ported RAM.

The RAM within MIRAN is divided into program, data, and buffer areas to satisfy the operating system and application code requirements. It can also provide temporary storage.

To optimize the installation of the MIRAN and the external connections to the MIRAN, it provides faceplate connections for occasional use of the external devices and the backplane or MDF connections for permanent connection of these external devices.

Figure 4 shows the hardware that the MIRAN is replacing and Figure 5 illustrates the basic MIRAN functional blocks. The functions of these blocks are discussed in this chapter following the figure.

Mechanical characteristics

The MIRAN resides in a IPE module card slot of a Meridian 1 system. It can be installed into any IPE card slot in the IPE module or into an SL-1 shelf that supports IPE cards.

Figure 4 shows the MIRAN card to the right of the arrow and the hardware it replaces, to the left of the arrow.

Figure 4
MIRAN and the equipment it replaces

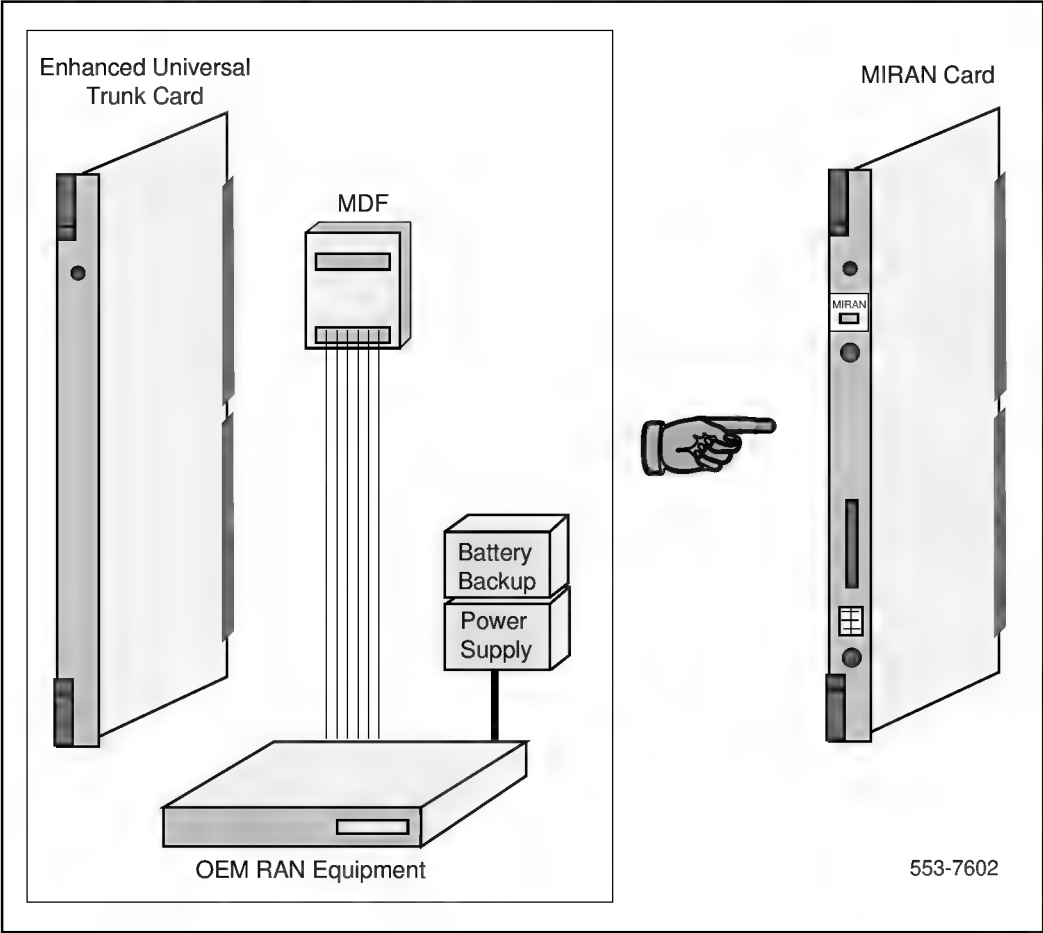
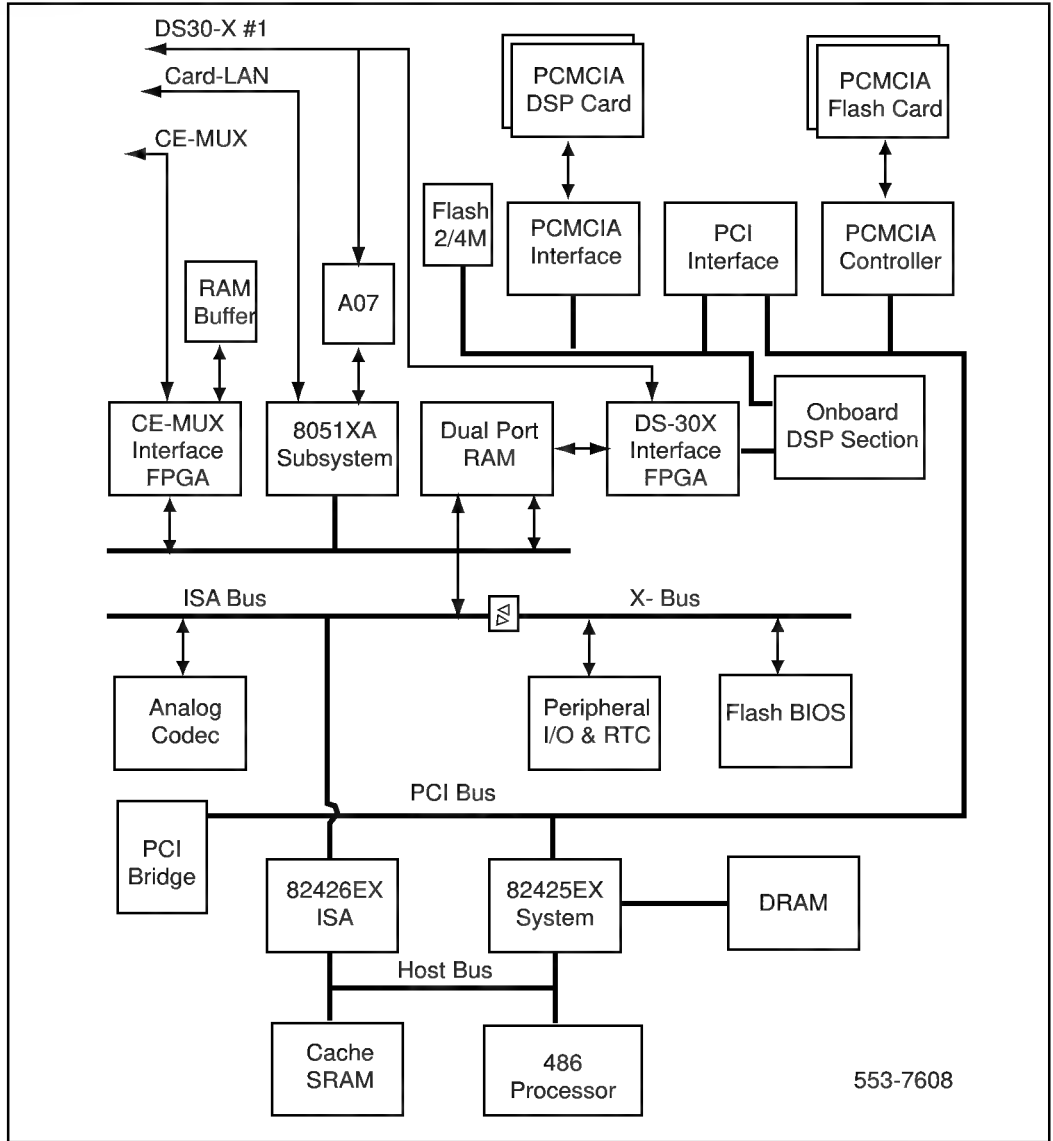


Figure 5 shows a high level block diagram of the MIRAN card components.

Figure 5
MIRAN block diagram



Faceplate connectors and indicators

The MIRAN faceplate provides the following interface connections:

Audio jack

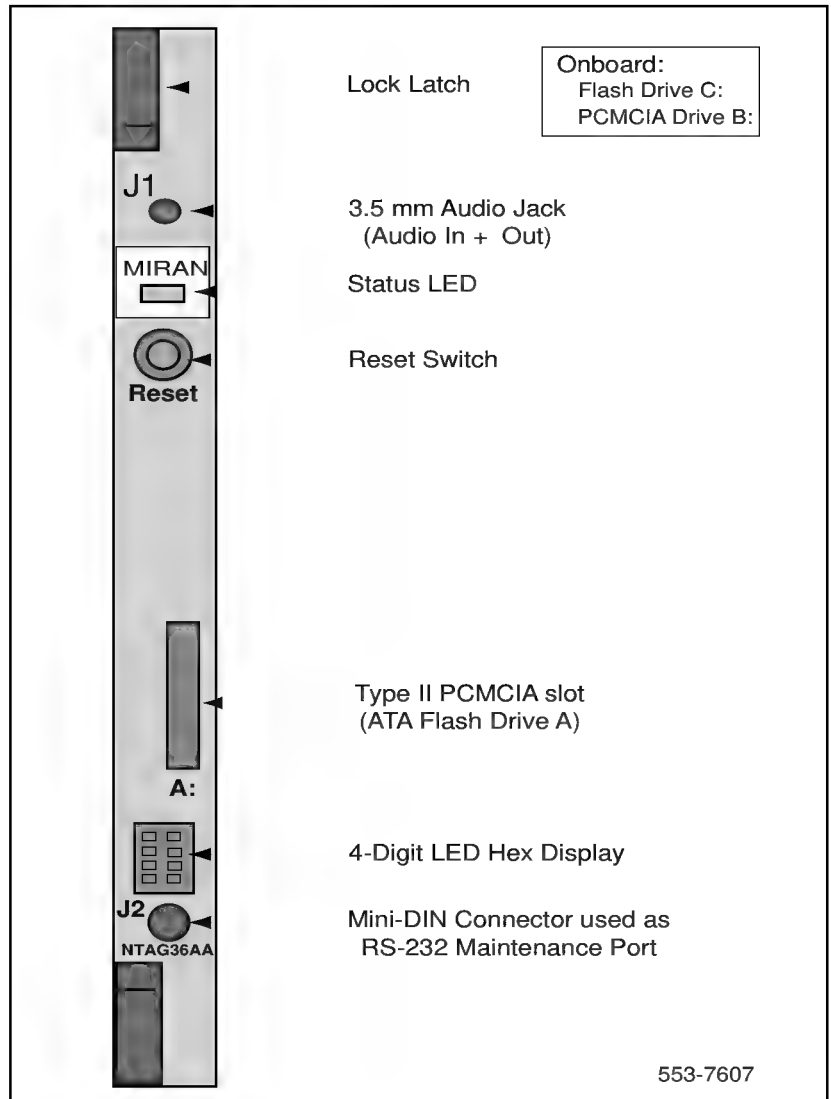
This 3.5 mm audio jack provides access to a single analog input and a single analog output. In addition, it is used to facilitate connection of external analog sources such as a tape recorder or CD player in order to record into MIRAN Flash memory or route it directly through a trunk emulation port into Meridian 1 for MOH. Alternatively, it can be used to back up messages from the MIRAN or to transfer them onto another MIRAN card.

The audio jack provides an external connection to Port 0 for a short term connection of an external analog source.

Where a permanent connection to an external music source is required, the external connection should be made at the backplane or the MDF not at the audio jack. At the backplane or the MDF, the port signals are duplicated and an additional audio input and output is provided.

Figure 6 shows the NTAG36 MIRAN card faceplate. It shows the connectors, a hex display, a status LED, a reset button, and PCMCIA card slots.

Figure 6
The NTAG36 MIRAN faceplate



Status LED

The MIRAN faceplate provides a single red LED to indicate the enabled/disabled status of the card and to indicate the self-testing result during power up or card insertion into an operational system.

Reset switch

The reset switch on the faceplate allows you to manually reset the MIRAN card. Normally, this switch is used to initiate a backup/restore or software upgrade from a PCMCIA-based Flash card or to clear a fault condition.

Dual Type II PCMCIA slot

This slot accepts standard PCMCIA cards including ATA Flash and Hard Disks that are Type II ATA compatible, as well as other peripheral cards as long as their respective drivers are available. This slot is used for MIRAN software upgrade, backing up messages, and storage.

Maintenance hex display

This is a four-digit LED-based hexadecimal display that provides the status of the MIRAN at all times. In addition, it provides an indication of fault conditions and the progress of PCMCIA-based software upgrades or backups.

It also indicates the progress of the internal self-test in the form of T:xx (refer to *Appendix A, MIRAN hexadecimal codes*). Upon successful completion of the test and the start-up of the RAN application, it will display the code “Rann”, where **nn** is the LAN card number. If cards are not connected in a LAN configuration the display will show Ra00.

RS-232 Asynchronous Maintenance Port

A mini-DIN socket on the MIRAN faceplate provides access to both RS-232 ports. This faceplate port will provide access to the MIRAN for both OA&M and debugging purposes, although it is only intended for occasional usage. This connector is duplicated on backplane or MDF tip and ring pairs where a permanent terminal connection should be made.

MIRAN backplane connections

In addition to the faceplate connections, the MIRAN provides an on board PCMCIA slot, two external cross-connect channels, audio ports, and RS-232 ports A and B at the backplane. Refer to Figure 16 “Multiple MIRAN card

connections over the RS-232 port at the MDF” on page 59. Port B connects to the terminal and port A is used together with port B for daisy-chaining multiple MIRAN cards (up to 16 cards) into a maintenance LAN.

On-board connector for PCMCIA

The MIRAN circuit board has a slot that accepts Type I, Type II, and Type III standard PCMCIA Flash cards. This connector is located on the MIRAN printed circuit board, not on the faceplate. This PCMCIA slot is used for expanding voice and music memory storage.

Multi cross-connect channel connection

Multi cross-connect channels are accessible at the backplane or at the MDF. These two external cross-connect channels can be cross-connected with 16 (600 Ohm) trunks or 16 (900 Ohm) trunks each to provide a total of up to 32 trunks cross-connections. (These channels do not emulate a trunk).

RS-232 port

A serial port is provided on the MIRAN card for maintenance functions. Access to this port is over tip/ring pairs on the backplane or at the MDF where a permanently connected terminal should be connected. This port is also accessible through the MIRAN faceplate mini-DIN connector for an occasional OA&M session and debugging purpose.

Analog ports

The MIRAN supports two analog input ports in order to connect external sources for recording messages and/or music, or, alternatively, to provide two analog channels that can be mapped into up to eight logical RAN units.

The audio jack on the MIRAN faceplate provides access to a single analog input and a single analog output. On the backplane or MDF, however, two analog inputs and two analog outputs are available for backing up stored messages onto audio cassette tape or, alternatively, for connecting to an external paging amplifier.

The left and right channels are independent of each other in order to provide two analog ports for recording and playback. Tip and Ring pairs at the MDF provide the ability to permanently connect the external analog sources to both Port 0 and Port 1.

DS-30X

This interface allows both signaling and timeslot access over standard IPE card.

IPE analog line and trunk cards convert the incoming analog voice and signaling information to digital form and route it to the Meridian 1 CPU over DS-30X network loops. Conversely, digital voice and signaling information from the CPU is sent over DS-30X network loops to the analog line and trunk cards where it is converted to analog form and applied to the line or trunk facility.

A DS-30X network loop is composed of two synchronous serial data buses that transport data:

- One bus transmits data toward the line facility (Tx)
- The other bus receives data toward the Meridian 1 CPU (Rx)

DS-30Y network loops extend between controller cards and superloop network cards, and function similarly to DS-30X loops. Essentially, a DS-30Y loop carries the PCM timeslot traffic of a DS-30X loop, but up to four DS-30Y loops form a *superloop* with a capacity of 128 channels (120 usable timeslots). See the NTP *Meridian 1 system engineering* (553-3001-151).

Card-LAN

This serial communications link is composed of two 19,200 baud asynchronous serial buses, both used by the Meridian 1 Peripheral Controller:

- The output bus, for sending control data to the MIRAN card
- The input bus, to receive the MIRAN card status data

In normal operation, the controller card continually scans (polls) all IPE cards connected to the Card-LAN to monitor their presence and operational status.

The Card-LAN link is used for communicating the basic card maintenance data and reading or programming the Card ID in the memory.

When an IPE line or trunk card is first plugged into the backplane, the system issues XMI002 message to indicate that it detected the card. The self-test is initiated. When the self-test is completed, a properly functioning card

responds to the next controller card poll with the self-test status. The controller then queries for card identification and other status information. The controller then downloads all applicable configuration data to the line/trunk card, initializes it, and puts it into an operational mode.

CE-MUX

The CE-MUX interface provides a standard multiplexed CPU bus to allow the MIRAN to emulate standard equipment circuit cards in order to provide Option 11E and 11C maintenance access.

MIRAN reset and self-test functions

Reset is executed immediately following a power-on or system-level reset, this procedure initializes the processor before proceeding with the power-on self-test. The MIRAN attempts to log the source of each reset condition. This information can later be displayed on the maintenance terminal to find the cause of the problem and time and date when it occurred.

Hard reset

A hard reset is equivalent to a card insertion or loss of power. It results in a total reset of all hardware elements and a full hardware and software initialization. A hard reset is always followed by a power-up sequence. This process may last up to 2 minutes.

A hard reset can be initiated by any of the following activities:

- card-level maintenance over the RS-232 port
- Meridian 1 maintenance
- MIRAN sanity reset
- excessive soft resets in a given time period
- by the administrator after upgrading MIRAN software

The excessive soft reset, refers to an attempt at software-level recovery that repeatedly fails. The only other option in that case is to reset the hardware and reload the operating system.

Soft reset

The soft reset re-initializes software elements on the card and corresponds to a reboot of the card. The system checks for the presence of an alternative boot source (e.g., a newly inserted PCMCIA Flash card) during soft resets. This process may last approximately 1 minute. During power up procedure, the system checks first drive A: then drive B: and finally drive C: for configuration information.

A soft reset can be initiated by any of the following:

- card-level maintenance
- Meridian 1 maintenance
- excessive sanity non-maskable interrupts in a given time period

The last situation would arise if a number of unsuccessful attempts were made to recover from a software (or hardware) error condition before exceeding a pre-defined threshold.

Executed immediately after a power-on or reset, this procedure:

- performs a minimum-level of hardware testing
- performs a full diagnostic check
- opens a communication path to an external maintenance terminal so that the MIRAN diagnostic status can be displayed during self test

Diagnostic self-test

This tests the installed hardware:

- determines the integrity of the hardware
- establishes MIRAN configuration in terms of its processor, RAM capacity, and Flash memory.

The MIRAN displays any unexpected results on the maintenance port and updates the Flash configuration. It may also indicate self-test results on the MIRAN faceplate hex display.

BIOS initialization

This process initializes the base hardware, using configuration information stored in Flash. The BIOS layer provides initialization and device drivers.

The BIOS layer initializes the hardware and boots the operating system, using the low level reset, self-test, and BIOS initialization.

Built-in monitoring functions

The operating system provides some form of low level access over a maintenance port for debugging purposes.

Sanity monitoring

This background task checks the sanity of the system, particularly in relation to other tasks that may be tying up CPU or memory resources. It attempts to restore normal MIRAN operation in cases where the performance has degraded to an unacceptable level. If all else fails, this task restarts the MIRAN in order to return to a functional state.

Responsibility for monitoring the MIRAN sanity is shared between the 486 and the 8051XA processors. The latter monitors the 486 by sending periodic diagnostic polling messages to which a response is expected within a given time period. Failure of the 486 to respond initiates a recovery procedure, which repeats the message at least two more times, followed by generating a soft reset to the 486, and eventually a full board-level reset. Failure to recover at that point results in a permanent error code on the hex display.

Error and alarm monitoring

You can access this facility from the OA&M module in order to monitor DS-30X and CE-MUX based messaging both to and from the Meridian 1. This resource can be particularly useful for debugging problems and for verifying functionality.

MIRAN expansion and upgrade

Software may be delivered by PCMCIA Flash card, and software upgrades using Flash PCMCIA. A PCMCIA Flash card without a configuration file is considered voice storage upgrade.

To install software upgrade or expand the port/channel capacity, you must install a new keycode.

Increasing voice storage

You can increase voice storage capacity to the maximum amount available on commercially available PCMCIA memory cards (by more than 5 hours, where each 1 Mbyte of memory provides 2 minutes of recording). Voice storage of up to 4 minutes is available on the basic MIRAN card. The PCMCIA card must be equipped with the ATA driver and an ATA compatible interface.

To expand the voice storage, insert a blank PCMCIA Flash card into faceplate drive A: or internal drive B: (drive C: is used for keycode storage). The MIRAN software checks the Flash card for formatting information. If none exists, the MIRAN will proceed to format the Flash card in DOS format. When formatting is completed, the full capacity of the Flash card will be available for storage. Use the on-board PCMCIA slot for voice memory expansion.

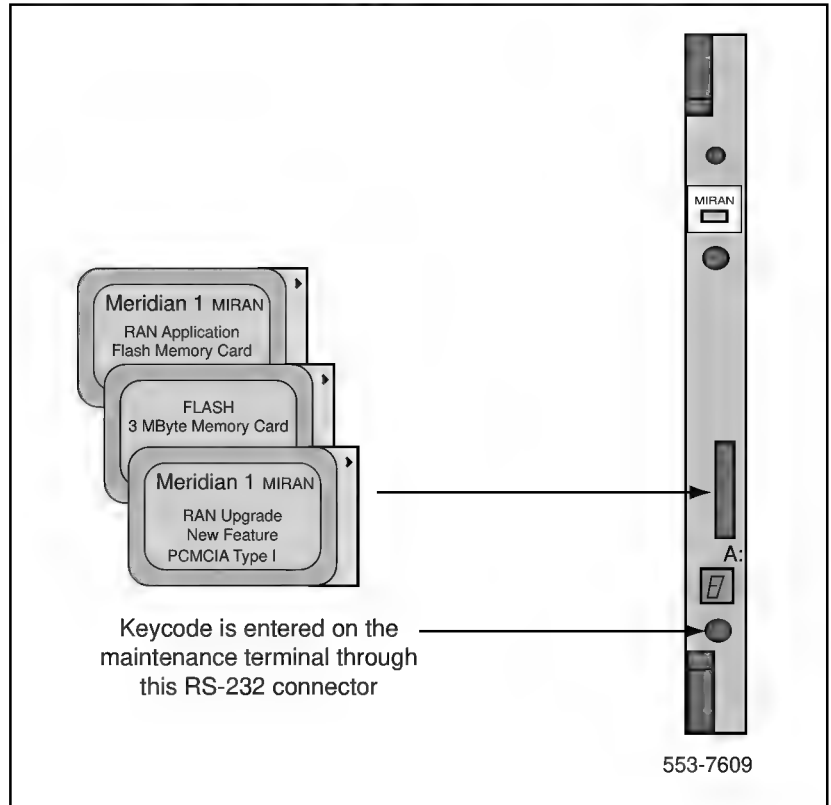
Upgrade using the PCMCIA cards

The faceplate PCMCIA slot (drive A:) is used for MIRAN feature upgrade or bug fixes. To upgrade MIRAN features, you must enter a new keycode. For bug fixes, you don't need a new keycode. MIRAN is compatible with any PCMCIA Flash card supporting the industry standard ATA interface.

When an upgrade PCMCIA card is inserted into the faceplate, the base code recognizes its presence but does nothing until an OA&M administration session takes place. This session instructs the base code how to use the new files and whether any spare Flash memory on the card can be used by a MIRAN application.

Figure 7 illustrates how PCMCIA cards are loaded into the MIRAN faceplate slots to upgrade the MIRAN capacity.

Figure 7
Installing a PCMCIA card into the MIRAN faceplate slot

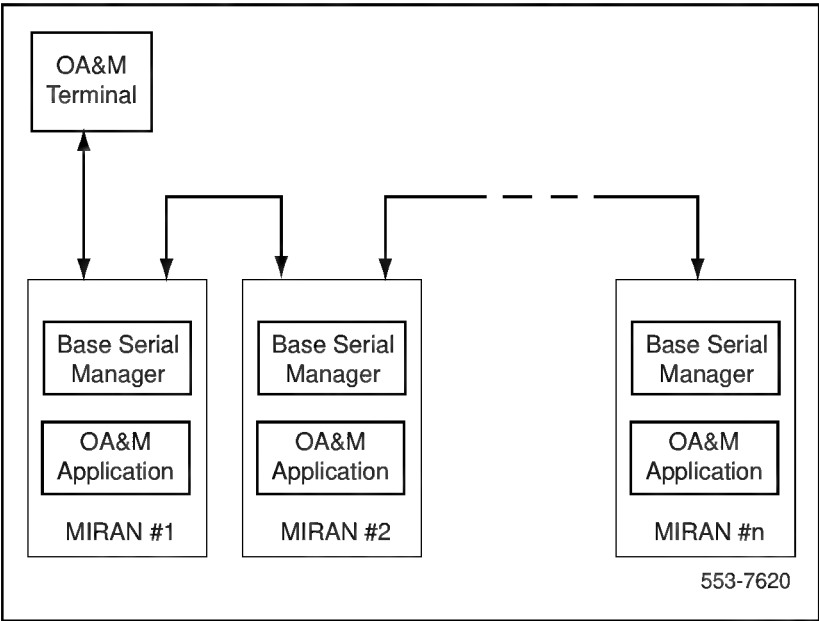


Expansion using multiple MIRAN cards in a LAN

If more MIRAN ports/channels are required than a MIRAN card can provide, up to 16 MIRAN cards may be linked together with maintenance cables to form a MIRAN LAN. For maintenance purposes they are joined together so that only one MIRAN needs to be connected to the maintenance terminal for the terminal to be able to access all MIRAN cards in the chain (in the LAN).

Figure 8 shows the daisy-chain connection of multiple MIRAN card in a LAN, where the OA&M terminal connected to one MIRAN can access any MIRAN in the chain.

Figure 8
Administration of multiple MIRAN card using terminal-based OA&M access



LAN messaging

LAN supports only two types of message, *configuration* and *data*, the latter of which uses the card address to specify the destination of the message. As a card receives a message header, it checks its validity and accumulates and processes the message if the address matches. Otherwise it passes it on to the next card in the chain.

All messages contain a checksum byte to detect errors. Part of the header also contains the number of bytes in the current message from 1 to 8 (excluding bytes in the header and checksum).

While the message for a card down the chain are passed on as they are received, they also accumulate at each node to allow retransmission of the entire message should a checksum failure occur. This reduces the delay in having to retransmit a corrupted message.

Multiple MIRAN message exchange

Because the first card in the chain transmits a LAN configuration message every five seconds, all of the other cards in the chain receive this message every five seconds also. Each card in turn that receives the message has a card ID number one greater than the ID number on the message received by the previous card as the message propagates down the line. If a new card is added at the start of the chain it starts initiating LAN configuration messages that causes all subsequent MIRAN cards to increment their card ID numbers by 1.

First card in chain.

If, after power-up, a MIRAN card fails to receive a valid LAN configuration message on Port A (the case for a card connected to a terminal or modem), it assumes that it is the first card in a chain and transmits a LAN configuration message on Port B with a card number of 1. It modifies its faceplate display to show the digit '0'. The card continues to transmit the LAN configuration message at 5-second intervals.

Subsequent cards in the daisy-chain.

If after power-up, a MIRAN card receives a LAN configuration message on Port A, it sets its card number to that contained in the message and retransmits the LAN configuration message on Port B with the card number incremented by 1. In this way, card numbers are propagated down the chain. As each MIRAN card receives a new LAN configuration message it updates the maintenance hexadecimal display with the number of the card currently receiving the message. Refer to Appendix A for a list of hexadecimal error codes.

LAN transit delays

At a rate of 9600 baud, each byte takes just over 1ms to transmit. Assuming for a maximum transmission and processing delay of 2ms at each node and allowing for a worst case of 16 cards, the delay to receive a message (assuming no retransmissions) would be:

$$2\text{ms} \times 15 = 30\text{ms (or 60ms for round trip)}$$

Because this delay usually results from data typed at a keyboard, it should not be significant.

Software security

To provide security for the RAN and music applications as well as to prevent unlawful product usage, the MIRAN uses a security device and keycode security approach.

Security overview

A security device and keycode mechanisms are needed to protect against unlawful MIRAN feature usage, because industry-standard PCMCIA cards are used as the software medium on the MIRAN. All upgrades of either channel capacity or application software are restricted to a given MIRAN card and are accurately tracked to allow for satisfactory handling of field repairs and incremental upgrades.

Security is required for the following upgrades:

- port/channel capacity upgrades; two are possible:
 - from one multi cross-connect channel to two
 - from four one-to-one ports/channels to eight
- feature enhancements
- new applications

Security is not required for the following upgrades:

- Flash memory capacity expansion
- customer recorded prompts
- backup and restore operations
- application patching/bug fix

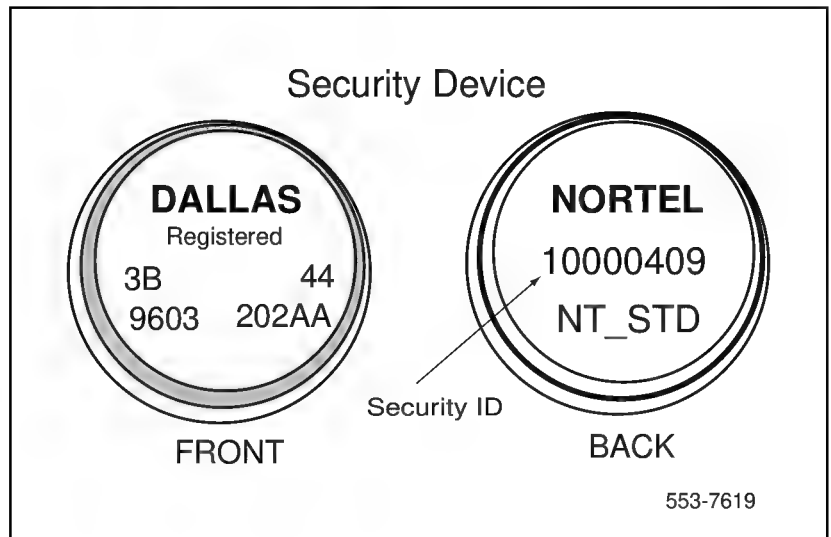
Security device

This button-sized device has a unique 12-digit laser-etched code that cannot be overwritten. In addition, it contains 1kbit of PROM to:

- identify the button as part of a Nortel product
- provide an 8-digit security ID

Figure 9 illustrates an example of a security device that contains a unique 12-digit laser etched code and 1kbit of PROM preprogrammed with Nortel specific information. The back of the security device shows the 8-digit security ID.

Figure 9
Example of a security device



Security ID

The security ID is the number that the customer must query from the MIRAN maintenance port prior to ordering an upgrade. It is read from the security device and it is unique for each MIRAN card.

The security ID can be found:

- at the top left-hand corner of the terminal-based OA&M menu or screen
- by using a command on the telephone set-based OA&M access
- on the shipping paperwork or box
- a sticker label on the card

Keycode

Nortel provides the customer with a keycode to enable them to install any desired upgrade. The keycode is entered over a terminal using the local maintenance port on the MIRAN card. The code consists of three sets of eight digits and must match the Security ID on the MIRAN card.

Keycodes can enable additional functionality within an existing application (adding ports, features, etc.) or can be used with a PCMCIA Flash card to provide new software features. The MIRAN comes from the factory equipped with a keycode, however, spare and repaired MIRAN cards are not equipped with a keycode nor with the security device. For the MIRAN to operate correctly, the keycode must be installed.

Engineering guidelines

Meridian 1 general system engineering guidelines are described in *Meridian 1 system engineering* (553-3001-151). The following information deals specifically with engineering guidelines for the MIRAN planning and implementation. For the MIRAN technical characteristics, refer to *Appendix B: Product integrity*.

System compatibility

The MIRAN is emulating the Enhanced Universal Trunk card RAN and MOH functions and uses the existing Trunk Administration LD 14 and Trunk Route Administration LD 16 programs to configure the MIRAN trunk parameters and MIRAN trunk routs.

To support the MIRAN functions, the Meridian 1 system must be running on X11 release 20 if multi-channel RAN mode is not required.

For multi-channel RAN mode support, X11 release 21.41 or later, or X11 release 22.16 or later software, is required.

Note: The multi-channel start/stop control RAN mode allows playing of the same recording independently on multiple channels over the same RAN route.

The MIRAN is supported by:

- Meridian 1 options 21E, 51, 51C, 61, 61C, 71, 81, and 81C (installed in any IPE card slot)

- SL-1 systems NT and XT upgraded to support IPE cards (installed in any IPE slot)
- Option 11E, and 11C (installed in all IPE slots, however, never install the MIRAN into card slot 10, it may get damaged)

MIRAN equipment

The MIRAN equipment can be tailored to meet a specific site and application requirements. You can select the number of ports/channels and the size of the memory required to support current and future requirements. The MIRAN is available in a basic form that provides limited number of ports/channels and minimum memory size. However, the basic MIRAN can be easily upgraded by building on the existing basic platform to expand the number of ports/channels and the memory size.

MIRAN channel capacity options

The MIRAN comes in three port/channel capacity options. These options are listed in Table 3.

Table 3
MIRAN channel capacity options

MIRAN option	Internal One-to-one ports/channels	Multi cross-connect channels	Telephone set based OA&M DID port
Small	4	1	7
Medium	4	2	7
Large	8	2	7 Note
Note: Port/channel number 7 is used as a DID port to connect the telephone set for recording purpose, therefore the large MIRAN option has only seven one-to-one channels available for RAN or MOH.			

For each option configured for a telephone set OA&M, port 7 must be configured as a DID port to connect to the telephone set. In this case, port 7 of the large MIRAN option with eight one-to-one internal ports/channels is used to connect to the telephone set for recording purpose and cannot be used for RAN or MOH application. Port/channel 7 may be reconfigured for RAN and MOH when not used for telephone set-based OA&M access.

The small and medium MIRAN options continue to have all four one-to-one ports/channels available for RAN and MOH because port/channel 7, which is used for telephone set- based OA&M connection, is not active for RAN and MOH in those two options.

Supported RAN modes

The MIRAN card supports the following RAN modes for the internal and the external channels:

- Internal one-to-one ports/channels support continuous and start/stop RAN and MOH modes.
- Internal one-to-one ports/channels support start/stop multi-channel RAN and MOH modes.
- External cross-connect channels support delay dial and immediate, continuous RAN and MOH modes.

Note: MIRAN supports Auto-Wake-Up. To configure this feature on MIRAN, refer to Automatic Wake Up in *X11 features and services* (553-3001-305)

Voice storage capacity

The MIRAN storage capacity can be expanded by installing PCMCIA ATA Flash cards into either the faceplate A: slot or the internal B: slot. However, Nortel recommends that the internal slot B: be used for voice storage and the faceplate drive A: be used for software upgrades.

Table 4 lists the memory size and the corresponding message recording time.

Table 4
MIRAN voice storage capacity expansion

Memory allocation	Recording time
Base MIRAN card memory	4 minutes
Base plus 40 MB Flash memory	84 minutes
A PCMCIA card 170 MB	340 minutes
Each additional 1 MB of Flash memory	2 minutes

Feature enhancement

The customer would be provided with a pre-programmed PCMCIA Flash card, which contains either feature enhancements or completely new applications. The keycode is required for this upgrade and can be entered on the TTY or terminal, or by using a keycode file on the PCMCIA Flash card.

Multi cross-connect channel characteristics

Table 5 displays electrical specifications for the MIRAN RAN cross-connect interface.

Table 5
Characteristics of the multi cross-connect channel

Characteristic	Specification
Terminal impedance	*600/900 ohms
Supervision type	Continuous, level, or pulse
DC signaling maximum loop length	600/900-ohm loop
Ground potential difference	± 1 V
* Up to 16 trunks with 600 Ohm and 16 trunks with 900 Ohm can be cross-connected.	

Power and ground requirements

Power to the MIRAN is provided by the IPE module power supply (AC or DC).

Note: Power supplied at the IPE module backplane at each card slot exceeds the power requirement for each MIRAN card. Therefore, there is no restriction on the number of MIRAN cards in the IPE module. If you are using hard drives that are powered by the IPE module, make sure that the total power requirements does not exceed power available for that card slot.

Table 6 displays the MIRAN power requirements. All values assume the use of a 3.3V processor.

Table 6
MIRAN power requirements

Configuration	+/-15V	5V	Total Power
Basic 8-port/channel	7.0 W	8.0 W	15 W
8-port/channel ± 4MB Flash	7.0 W	8.3 W	15.3 W

The maximum IPE module per slot power budget is 30 Watts, with an effective limitation of 20 Watts for thermal compensation. A DC/DC converter is used to provide the 3.3 volts required by the 486 processor and the PCMCIA interfaces.

Note: Power supplied at the IPE module backplane at each card slot exceeds the power requirement for each MIRAN card. Therefore, there is no restriction on the number of MIRAN cards in the IPE module.

Table 7 shows the maximum current required from each power supply rail.

Table 7
Backplane power available (per card slot)

Supply Rail	Available on backplane	With DC-DC converter	MIRAN
3.3 V	—	2400 mA	8 W
5 V	2000 mA	2000 mA	10 W
+/- 15 V	800 mA	366 mA	10 W

The processor contains three separate grounds: logic, analog, and frame. Logic ground is connected to the processor ground. The codec has its own separate analog ground that connects to the logic ground at a single point.

No connection between logic ground and frame ground is provided on either the processor or the expansion board. Instead, these two grounds are connected at the shelf where the MIRAN card is installed.

Each MIRAN I/O port routed to the backplane has its own ground to simplify connections.

External equipment

The MIRAN can perform RAN applications without any external connections. However, to perform OA&M sessions, connect external music sources to the MIRAN, to record RAN messages or music, you must connect the external devices to the MIRAN faceplate connectors, or to the backplane or MDF tip/ring pairs.

VT100 type terminal

A VT100 terminal or a personal computer emulating a terminal is used to perform RAN and MIRAN administration, access and configuration of any MIRAN in a LAN configuration of up to 16 MIRAN cards in a daisy-chain, and maintenance and diagnostics of each MIRAN.

A maximum of 16 MIRAN cards can be daisy-chained into a LAN connection to provide access to each MIRAN card from a single terminal.

A terminal can use:

- a menu system to perform administrative and maintenance functions, or
- commands that are entered on the command line

The terminal must be connected to the MIRAN RS-232 interface. The connection can be made:

- at the mini-DIN connector on the MIRAN faceplate using the NTAG81CA or NTAG81DA Maintenance Cable for occasional use, or
- at the MDF tip/ring pairs using a terminal cable that must be less than 50 feet long (cable not supplied)

For a Single Terminal Access (STA), MIRAN can be connected to an MSDL port operating in the STA mode. This way, MIRAN and other application cards installed in the system can be accessed from a single terminal.

Terminal interface must be set at 9600 baud, 8 data bits, 1 stop bit, and no parity. The flow control is not supported.

Table 8 lists the terminal-based OA&M access method for different system options over the SDI or MSDL ports.

Table 8
Terminal-based OA&M access for different system options

System option	Access description
Option 11 - remote	Connect system SDI port with a PCMCIA modem on the MIRAN or over the MIRAN RS-232 port. MIRAN looks for "VPS<cr>" after login.
Option 11 - local	Connect system SDI port over the MIRAN RS-232 port. MIRAN looks for "VPS<cr>" after login.
Meridian 1 Options 21-81C	Use STA feature on the MSDL card where MIRAN is an STA monitored system.
Option 11C	Use passthru feature of Option 11C for terminal emulation on System Management Products (SMP).
Option 11E	Access over CE-MUX.

Telephone set for OA&M access

No external connections are required as long as you use an existing telephone in the system.

To perform a telephone set-based OA&M access, you have to set one of the internal one-to-one MIRAN ports/channels (port 7) to be a DID trunk in the Meridian 1 system. The DID trunk route makes the MIRAN port 7 accessible by using a route access code from any telephone in the system. To access a MIRAN a valid password must be entered. Small and medium size MIRAN options also use port 7 for telephone set OA&M access.

External analog sources

The external analog sources provide a facility to connect tape recorders, CD players for recording onto the Flash memory on the MIRAN, or to record messages from the MIRAN onto a tape for backup, or to record these backed

up messages to an other MIRAN card. Refer to Figure 14 “Analog device connection at the MDF” on page 55 in the *Installation and administration* section.

You can connect these external analog sources to the:

- 3.5 mm Audio Jack on the MIRAN faceplate (one input and one output) by using the NTAG81AA Audio Cable
- at the backplane or the MDF tip/ring pairs (cable not supplied)

Engineering a MIRAN RAN and music application

Based on the options of the MIRAN equipment, external equipment, and your RAN and MOH requirements, you can engineer a MIRAN system to meet your system requirements.

The following five examples illustrate what equipment is required for a specific site (application) requirements. It also discusses the alternatives available for interconnection of multiple MIRANs and connection of external devices to the MIRAN.

Example 1:

Application requirements:

- Provide three internal RAN channels and one external cross-connect channel to cross-connect 10 trunk ports.
- Provide 1 hour of recording space on the MIRAN card.
- Provide telephone set-based OA&M access.

Equipment requirements:

- one medium MIRAN
- one 40 MB PCMCIA ATA Flash card
- two Enhanced Universal Trunk cards

Example 2:

Application requirements:

- Provide multi-channel level start/stop control RAN mode for four internal RAN channels and two external cross-connect channels to cross-connect 30 trunk ports.
- Provide 4 minutes of recording space on the MIRAN.
- Provide terminal-based OA&M access.

Equipment requirements:

- one medium MIRAN
- four Enhanced Universal Trunk cards
- one NTAG81CA Maintenance Cable (to connect the terminal to the mini-DIN connector on the MIRAN faceplate), or alternately
- a terminal-to-MDF cable where total distance from the MIRAN through the MDF to the terminal is less than 50 feet

Note: In this mode, all four ports/channels are playing the same announcement independently over the same RAN route.

Example 3:

Application requirements:

- Provide seven internal RAN channels and two external cross-connect channels to cross-connect 30 trunk ports.
- Provide 2 hour of recording space on the MIRAN.
- Provide terminal-based OA&M access.

Equipment requirements:

- one large MIRAN
- one 60 MB PCMCIA ATA Flash card
- four Enhanced Universal Trunk cards
- one NTAG81CA Maintenance Cable (to connect the terminal to the mini-DIN connector on the MIRAN faceplate), or alternately

- a terminal-to-MDF cable where total distance from the MIRAN through the MDF to the terminal is less than 50 feet

Example 4:

Application requirements:

- Provide 11 internal RAN channels and 3 external cross-connect channels to cross-connect 40 trunk ports.
- Provide 5 hour of recording space on the MIRAN.
- Provide telephone set-based OA&M access, and
- Provide terminal-based OA&M access.

Equipment requirements:

- one large MIRAN with 170 MB PCMCIA ATA Flash memory, and
- one basic small MIRAN
- five Enhanced Universal Trunk cards
- two NTAG81DA Maintenance Splitter Cable (to inter-connect the two MIRAN cards to their respective mini-DIN connectors on the MIRAN faceplate and to connect the terminal), or alternately
- cross-connect the RS-232 ports of the two MIRAN at the MDF and use a terminal-to-MDF cable to connect the terminal to one MIRAN if the distance between the MIRAN and the terminal through the MDF is less than 50 feet

Note: The total number of internal one-to-one ports/channels are 12. Even though we have a telephone set-based OA&M, if we use port 7 of the small MIRAN card we do not loose an active channel and have all 12 channels available for RAN or MOH applications.

Example 5:

Application requirements:

- Provide 14 internal RAN channels and 4 external cross-connect channels to cross-connect 60 trunk ports.
- Provide 5 hour of recording space.
- Provide two external analog (music) sources

- Provide telephone set-based OA&M access, and
- Provide terminal-based OA&M access.

Equipment requirements:

- two large MIRAN with 170 MB PCMCIA ATA Flash memory
- eight Enhanced Universal Trunk cards
- two NTAG81AA Audio Cables to connect external analog sources, or instead of using the NTAG81AA cables, you can connect the external analog sources at the MDF
- two NTAG81DA Maintenance Splitter Cable (to inter-connect the two MIRAN cards to their respective mini-DIN connectors on the MIRAN faceplate and to connect the terminal), or alternately
- cross-connect the RS-232 ports of the two MIRAN at the MDF and use a terminal-to-MDF cable to connect the terminal to one MIRAN if the distance between the MIRAN and the terminal through the MDF is less than 50 feet

Note: The total number of internal one-to-one ports/channels are 16. However, we have to use port 7 of one of the MIRAN as a DID port to connect a telephone set-based OA&M, therefore only 15 channels are available for RAN or MOH applications.